WHAT IS CLAIMED IS:

1. A nitride semiconductor substrate having a diameter of 10 mm or more, which has a single-layer structure composed of a nitride semiconductor layer having a basic composition represented by $Al_xGa_{1-x}N$ ($0 \leq x \leq 1$), or a multi-layer structure comprising said nitride semiconductor layer, the mass density of said nitride semiconductor layer being 98% or more of a theoretical mass density ρ (x) represented by the following general formula (1):

$$\rho(x) = \frac{4(M_x + M_N)}{\sqrt{3}a_x^2 c_x N_a} \quad \cdots (1),$$

wherein $a_x = a_{GaN} + (a_{AlN} - a_{GaN})x$, wherein a_{GaN} represents an a-axis length of GaN, and a_{AlN} represents an a-axis length of AlN; $c_x = c_{GaN} + (c_{AlN} - c_{GaN})x$, wherein c_{GaN} represents a c-axis length of GaN, and c_{AlN} represents a c-axis length of AlN; $M_x = M_{Ga} + (M_{Al} - M_{Ga})x$, wherein M_{Ga} represents the atomic weight of Ga, and M_{Al} represents the atomic weight of Al; M_N represents the atomic weight of nitrogen; and N_a represents Avogadro's number.

2. The nitride semiconductor substrate according to claim 1, wherein it is a self-supported substrate composed of said nitride semiconductor layer.

3. The nitride semiconductor substrate according to claim 2, wherein said nitride semiconductor layer has a thickness of 200 μm or more.

4. The nitride semiconductor substrate according to claim 1, wherein a distribution of said mass density is within ± 0.1% in a plane.

5. The nitride semiconductor substrate according to claim 1, wherein a distribution of said mass density is within ± 0.2% in a thickness direction.

6. The nitride semiconductor substrate according to claim 1, wherein said nitride semiconductor layer is composed of a single crystal.

7. The nitride semiconductor substrate according to claim 1, wherein said nitride semiconductor layer has a threading edge dislocation density of 1×10^7 cm^{-2} or less.

8. A method for producing the nitride semiconductor substrate according to claim 1, wherein said nitride semiconductor layer is grown by a hydride vapor-phase epitaxy method.

9. The method for producing a nitride semiconductor substrate according to claim 8, wherein a nitrogen compound gas used as a starting material for said nitride semiconductor layer has a partial pressure of 50 kPa or more.

10. The method for producing a nitride semiconductor substrate according to claim 8, wherein said nitride semiconductor layer is epitaxially grown on a different substrate.

11. The method for producing a nitride semiconductor substrate according to claim 10, wherein the epitaxially grown nitride semiconductor layer is separated from the different substrate to provide a self-supported substrate of a nitride semiconductor.

12. The method for producing a nitride semiconductor substrate according to claim 8, wherein after said nitride semiconductor layer is epitaxially grown, a heat treatment is conducted in an atmosphere containing a nitrogen compound gas.

13. The method for producing a nitride semiconductor substrate according to claim 12, wherein said heat treatment is conducted at a pressure of 4 MPa or more.

14. The method for producing a nitride semiconductor substrate according to claim 12, wherein a heat treatment temperature is 400-1200°C.